RVGSS SAMPLE TASK ORDER # 1

TASK ORDER TITLE: Robotics Simulation Services

PERIOD OF PERFORMANCE: May 28, 2014 – May 27, 2015

TASK OVERVIEW:

The objective of this task is to provide simulation development, integration, verification, validation, analysis, documentation, maintenance, and troubleshooting support for space-based robotics modeling and simulation efforts managed by the Engineering Directorate. The resulting non-real-time (NRT) and real-time (RT) robotics simulation applications have traditionally been used in support of procedures development, engineering analysis, and crew/flight controller training. In accordance with Statement of Work 3.1, Robotics Simulation Services, the contractor shall provide the technical requirements listed below.

TECHNICAL REQUIREMENTS:

1. The Engineering Directorate has historically used highly efficient articulated rigid and flexible multibody dynamics packages for space-based robotics modeling and simulation. The Engineering Directorate has a need to update these capabilities to a more object-oriented approach while at the same time maintaining seamless integration with existing integrated manipulator/orbital dynamics, hard surface contact dynamics, and dynamic state transition management models. The contractor shall develop the technologies listed below and prototype their use on selected project as indicated.

    1.1. *Next Generation MBDyn* – The contractor shall develop the next generation, object-oriented version of MBDyn, ensuring compatibility with integrated multibody/orbital dynamics capabilities, generic contact dynamics capabilities, and dynamic state transition management. This new version shall be fully developed, documented (both in terms of formulation and implementation), verified, validated, and configuration managed per NASA STD 7009.

    1.2. *VV Simulation Prototype* - Using this new version of MBDyn and other capabilities above, the contractor shall prototype an integrated visiting-vehicle capture NRT analytical simulation beginning with the vehicle ready to capture through capture transition, maneuver, and ultimate berth to a receiving berthing mechanism. A specific International Space Station (ISS) scenario that this prototype could be applied to would include a Japanese Space Agency (JAXA) HII Transfer Vehicle (HTV) capture and berth to a Common Berthing Mechanism (CBM) using the Space Station Remote Manipulator System (SSRMS) on the International Space station (ISS) in an orbital setting.

2. Operation of ISS-based robotic systems has traditionally relied heavily on RT training simulators and simulation facilities for crew, flight controllers, and instructors. The Engineering Directorate has a need to continue this type of training support throughout the life of the ISS.

   2.1. *DST Maintenance* – The contractor shall maintain the Dynamics Skill Trainer (DST) used within the Systems Engineering Simulator (SES), other DST facility sites at the Johnson Space Center, Russia Space Agency (Star City, Russia), and European Astronaut Centre (Cologne, Germany). Maintenance can be performed remotely and travel is not required. The contractor shall support all simulation applications considered to be part of the DST simulation suite, including the Canadian Space Agency (CSA) Mobile Servicing System (MSS), HTV, Commercial Orbital Transportation Services (COTS) (SpaceX Dragon/ Orbital Cygnus), and JAXA Japanese Experiment Module Remote Manipulator System (JEMRMS) and shall be ready to respond to new system requirements should those arise. Installation and verification checkout shall be performed whenever a new software release is delivered, including migration to newer Operating System (OS) releases. Real-time operations and facility troubleshooting support shall also be provided.

   2.2. *ROBoT Maintenance* – The contractor shall provide sustaining engineering for the Robotics On-Board Trainer (ROBoT) onboard training T61p laptop architecture including MSS, HTV, COTS (Dragon/Cygnus) and JEMRMS. Continual integration, test, and flight certification through Government Certification Acceptance Request (GCAR) and all that it entails of ROBoT-based applications is addressed within this subtask requirement. The contractor shall also provide in-lab (prior to mission) and RT mission on-board training support as required, both in the DST Technology Laboratory as well as from the Multi-Purpose Support Room (MPSR).

   2.3. *TS21 ICDE Maintenance* - Support continuation of the 21st Century Training Systems (TS21) Modeling and Simulation (M&S) Integrated Core Dynamics Engine (ICDE) capabilities needed for TS21-based ISS and Visiting Vehicle (VV) simulations post Operational Readiness Review (ORR) sustaining engineering. These capabilities include MBDyn, integrated multibody/orbital dynamics, and dynamic state transition management. Contact dynamics and mechanism models of the Common Berthing Mechanism (CBM) and Common Attachment System (CAS) should also be maintained. ICDE maintenance release updates should be regression tested according to TS21 integrated testing requirements.

DELIVERABLES & SCHEDULES:

1. Subtask 1 deliverables:
   A. Initial object-oriented MBDyn version (November 28, 2014). Version should be compatible with Trick 13.x.

B. Follow-up object-oriented MBDyn version (May 27, 2015). Version should be compatible with Trick 13.x.
C. Integrated visiting vehicle capture simulation prototype (May 27, 2015).

2. Subtask 2 deliverables:
   A. Initial DST software release pushed to supported facilities (November 28, 2014).
   B. Follow-up DST software release pushed to supported facilities (May 27, 2015).
   C. Initial ROBoT software uploaded to ISS (September 30, 2014).
   D. Updated ROBoT software release uploaded to ISS (January 30, 2015).
   E. Final ROBoT software release uploaded to ISS (May 27, 2015).
   F. Initial ICDE software release incorporated within TS21 facility (November 28, 2014).
   G. Final ICDE software release incorporated within TS21 facility (May 27, 2015).

DEPENDENCIES:

NASA shall provide access to required development resources including workstations, laptops, network infrastructure, software licenses, avionics system engineering units, vehicle and environment simulations, and supporting tools resources at JSC.